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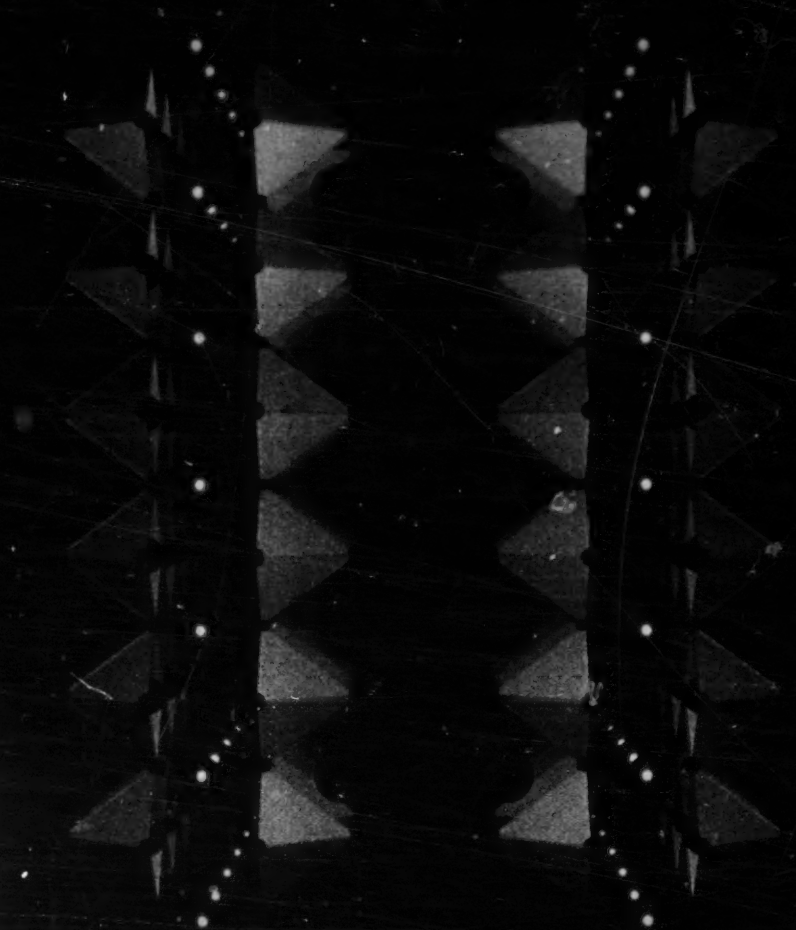
NOVEMBER 27, 1989

CHEMICAL & ENGINEERING

NEWS



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High-Temperature Superconductors

Advances made in applications of new materials

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CHEMICAL & ENGINEERING
NEWS
Volume 67, Number 48
CENEAR 67 (48) 1-76
ISSN 0009-2347
NOVEMBER 27, 1989

News of the Week

■ **New analysis by NOAA researchers suggests that significant ozone loss may be occurring at high southern latitudes outside the Antarctic ozone hole.** **Page 6**

■ **Bush stance on chemical arms continues to stir confusion, concern, and opposition both within the U.S. and overseas.** **Page 7**

■ **Clean air legislation to have priority on Senate agenda when Senate reconvenes on Jan. 23.** **Page 7**

■ **S. Allen Heininger, corporate vice president for resource planning at Monsanto in St. Louis, has been elected ACS's 1990 president-elect.** **Page 7**

■ **The European Community is on the verge of offering free-trade status to six oil producing countries in the Middle East.** **Page 8**

Cover: Computer-generated crystal structure of yttrium-barium-copper oxide high-temperature superconductor. Photo courtesy of IBM

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Business

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East bloc industry likely will become more trade- and customer-oriented as a result of current moves in Eastern Europe toward democratization. **Page 32**

Government

Academies' report calling for farmers to adopt low-input methods is drawing heavy criticism. **Page 38**

NIH-proposed ethical guidelines for researchers are widely regarded as overkill. **Page 42**

FDA Commissioner Frank Young will leave the agency for a new post at the Department of Health & Human Services. **Page 45**

Science/Technology

U.S. holds back on rejoining UNESCO during recent Paris meeting but sends observers to discussions involving group's science, education programs. **Page 47**

Education

Report, recommendations on science education presented to Congress by ACS's Society Committee on Education. **Page 54**

News Focus

In push toward commercialization of high-temperature superconductors, big firms, startup companies, industry consortia, government agencies, and national labs are striving to perfect the processing of the ceramic materials. **Page 9**

Chemical & Engineering News
1155—16th St., N.W., Washington, D.C. 20036
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Published by
AMERICAN CHEMICAL SOCIETY
(202) 872-4600; TDD (202) 872-8733
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Subscription Rates 1989. Printed editions: nonmembers U.S. 1 yr. $55, 2 yr. $99, outside U.S. 1 yr. $86, 2 yr. $161. Air freight rates available on request. Rates above do not apply to nonmember subscribers in Japan, who must enter subscription orders with Maruzen Co. Ltd., 3-10 Nihonbashi 2-chome, Chuo-ku, Tokyo 103, Japan. Tel: (03) 272-7211. Single copies: Current $8.00. Rates for back issues and volumes are available from Microforms & Back Issues Office, ACS, 1155—16th St., N.W., Washington, D.C. 20036. Back and current issues available on microfilm and microfiche. Rates on request from Microform Program, ACS.

Chemical & Engineering News (ISSN 0009-2347) is published weekly except for the last week in December by the American Chemical Society at 1155—16th St., N.W., Washington, D.C. 20036. Second-class postage paid at Washington, D.C., and additional mailing offices. POSTMASTER: Send address changes to Chemical & Engineering News, Membership & Subscription Services, P.O. Box 3337, Columbus, Ohio 43210. ACS assumes no responsibility for the statements and opinions advanced by the contributors to its publications.

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LETTERS

Liquid oxygen hazard

SIR: I am writing in reaction to the letter of M. H. Gitlitz (C&EN, Sept. 25, page 5) on informed risk perception. I quite agree with his conclusions about the need for rational attitudes about chemicals among the public, firefighters, and the media; however, the example he cites of an inappropriate response having to do with spillage of liquid oxygen on the New Jersey Turnpike may, in fact, have been an appropriate response. According to R. Gerlach in an article titled "Flammability, Combustibility" [in Young, J. A., editor, "Improving Safety in the Chemical Laboratory: a Practical Guide," Wiley-Interscience, New York, page 75 (1987)], "Liquid oxygen in contact with combustible materials can cause spontaneous fires to erupt. When liquid oxygen soaks into relatively noncombustible asphalt, the combination is a high explosive, sensitive to heat or shock." If the segment of the New Jersey Turnpike in question was asphalt, then the emergency response was appropriate.

Nancy M. Tooney
Associate Dean of Arts and Sciences,
Associate Professor of Biochemistry
Polytechnic University

Monosaccharide linkages

SIR: The article by Stephen Stinson, "Controlled Linkage Techniques for Monosaccharides Introduced" (C&EN, Aug. 28, page 25), reviewed two reports from Samuel Danishefsky's laboratory that were published in the *Journal of the American Chemical Society*. Although not wishing to comment on the chemistry that is introduced in these articles, I would like to remind (or inform) your readers of prior art in four relevant areas of carbohydrate chemistry so that proper historical perspectives will be preserved.

First, no discussion of controlled linkages of monosaccharides via 1,2-anhydro sugars should ignore Raymond Lemieux's 1953 triumph over sucrose [*J. Am. Chem. Soc.*, **75**, 4118 (1953)], described even today by R. T. Morrison and R. N. Boyd ["Organic Chemistry," 3rd ed., Allyn and Bacon Inc., Newton, Mass. (1987)], as "the Mount Everest of organic chemistry."

This omission may be attributable to the opening sentence of the second JACS article [**111**, 6661 (1989)]: "The possibility of using 1,2-anhydro sugars as glycosyl donors has been recognized, but not extensively exploited." These assessments do not convey the painstaking and scholarly series of investigations that led to Lemieux's conquest. Thus, Stinson's "α-epoxides" are similar to Brigl's anhydride, the reactions of which have been investigated by carbohydrate chemists for 50 years. Lemieux's pivotal observation was that primary alcohols opened the epoxide to give trans products (i.e., β-glucosides), whereas hindered alcohols gave appreciable cis openings (i.e., α-glucosides). The rationalization of these results was a triumph for conformational analysis, made more impressive by the then embryonic nature of that concept. The "alcohol" on the fructose moiety of sucrose is tertiary, hence the logic of his achievement.

Second, the single mention of Lemieux's work in the C&EN article comes in paragraph 11 in connection with the haloalkoxylation of glycals described in the first JACS article [**111**, 6656 (1989)]. Lemieux developed iodonium dicollidine perchlorate expressly for use with glycals, and in considering the "controlled linkage [of] monosaccharides," your readers might be interested to know that the reagent was used by David Iley in our laboratory for the key step leading to the first strategically different (and the first completely stereoselective) route to sucrose [*J. Am. Chem. Soc.*, **97**, 2563 (1975)].

However, of much greater impact is the extensive body of work by Joachim Thiem over the last 10 years, described in over 40 papers, which include important strategies for synthesizing the troublesome 2-deoxy-β-anomers. His syntheses of the oligosaccharides from the aureolic acids, mitramycin, digitoxosides, and anthracyclines, are representative of his expertise.

Third, the subhead of the C&EN article, "Methods allow automation of oligosaccharide production..." echoes the final sentence of the second JACS article: "Possibilities of a reiteratable and automatable scheme for oligosaccharide synthesis...are currently being evaluated." In view of the absence of appropriate citations, your readers should be aware of the pioneering and extensive work of Scheurch (U.S.), Frechet (Canada), and Kochetokov (U.S.S.R.) for nearly 20 years on both solid-phase and polymerization routes to oligosaccharides. Those inclined to compare oligosaccharide and oligonucleotide automated syntheses ignore the stony terrain covered by these investigators at their peril.

Fourth, in amplification of the fifth paragraph of the C&EN article, it should be noted that the idea of utilizing a functional group in oligosaccharide synthesis to "control the traffic" (to use

Overcapacity Slimming Earnings For Polypropylene Producers

Decreasing consumption and expanding capacity are driving down operating rates, resulting in price cuts and lower profits

Bruce F. Greek, C&EN Houston

Polypropylene, which for three years was riding the crest of a major boom, has slipped into leaner times. All the signs point to lower profits for producers. Reduced demand and expanding facilities are leading to overcapacity with attendant price cuts to maintain competitive positions. Export prices for homopolymer grades of polypropylene, for instance, have dropped to half those of late spring, and prices for sales within the U.S. have dropped to a third of what they were.

Polypropylene output this year will grow at the lowest rate since the recession of the early 1980s. Capacity expansions now completed or expected to be completed in 1990 will far exceed demand growth. Within a year, overcapacity will drive down average plant operating rates to about 83% of nameplate capacity, the lowest in seven years. Except in the limited volume specialties, selling prices of most polypropylene resins have fallen since the summer, as the size of the overcapacity and the excessive inventory growth have become evident.

Polypropylene was first of the large-volume plastics to enter the current cycle of demand buildup, capacity expansion, and subsequent overcapacity. Demand for the plastic soared in 1986, while demand for other plastics recovered more slowly from the recession. Improved polymerization technology and low prices led to the production of numerous new polymers and to new uses of polypropylene, spurring unexpected demand. Continued strong exports also helped to increase demand. With demand at an apparently insatiable point, prices soared to new highs for recent times.

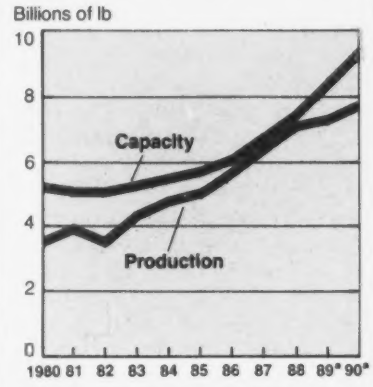
By the second quarter of this year, polypropylene demand and pricing had peaked, according to several industry sources. Interpolymer competition became serious and exports declined slightly, which started a slide in demand and prices. Inventory building, already under way, increased as new capacity for polypropylene came on stream. Spot prices for resins going to export markets recently fell to less than 30 cents per lb, half of spot prices about a year ago. The slumping prices then started the expected pulldown of inventories.

Under the pressure of capacity additions for next year forecast at as much as 15% of those in mid-1989, prices will weaken further, according to industry sources. Polymer-grade propylene prices also have fallen. The declines in propylene prices reflect efforts by monomer producers to bolster polymer profit margins and also are a reaction to additional propylene production and purification capacity that has come on stream this year. Unless current crude oil and natural gas prices go even higher, propylene prices likely will follow ethylene prices down, as the wave of new steam-cracking capacity starts up. Lower prices for the monomer will somewhat help margins, as polymer prices keep sliding.

Lower prices and increased overcapacity for polypropylene will continue for at least another year. The plastic will regain some of the uses lost to other polymers, and development of new uses will be spurred, as happened during the first half of the 1980s. The shift toward greater use of polypropylene in various fabricated items will accelerate temporarily as a result of the recent loss of a large amount of Phillips 66's capacity to make high-density polyethylene (HDPE) because of an explosion and fire at its Pasadena, Tex., plant (C&EN, Oct. 30, page 4). Spurred by lower prices, demand will begin to grow substantially again in the early 1990s, according to industry sources. Hence, polypropylene will have the advantage of being the first of the major polymers to have tight supply with rapid runup in prices, followed by large capacity buildup, oversupply, and slump in prices, with the cycle repeating itself.

Meanwhile, polypropylene producers must cope with a profit squeeze and lower capacity use. The methods they are using to overcome these problems make it difficult to forecast production and capacity use

Polypropylene output slows as capacity climbs



a Forecast. **Sources:** Committee on Resin Statistics of the Society of the Plastics Industry, C&EN estimates

in 1990. For example, inventory reduction under way during the third quarter of this year was larger than expected as, at the same time, production was reined in. This meant that smaller quantities of higher cost polymer (based on present monomer and processing costs) were made that will need to be sold at low margins to compete with the lower cost polymers now being produced and those to be produced later.

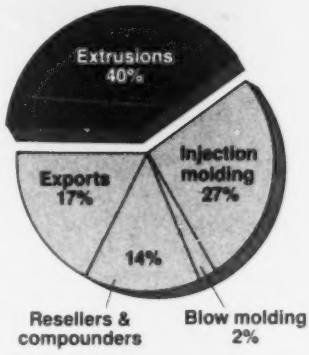
Relative to output, however, inventory reduction will be small. For example, during the first six months of this year, polypropylene production totaled 3.80 billion lb, according to preliminary estimates by the Committee on Resin Statistics of the Society of the Plastics Industry as compiled by Ernst & Young. During the same period, sales and captive use totaled 3.68 billion lb. Therefore, about 120 million lb of polypropylene, or about 3% of production, must have gone into inventory. With production at more than 600 million lb per month, such an inventory addition could be eliminated in a few months through relatively minor reductions in plant operations, including shutdowns for maintenance.

The polypropylene inventory undoubtedly was reduced during the third quarter and so far in the fourth quarter. Inventory reduction has been unexpectedly high as a result of the shutdown of Phillips' polypropylene unit at Pasadena coincident with the disaster at the firm's HDPE plant. Phillips restarted the polypropylene unit with 480 million lb of annual capacity earlier this month.

The industry's inventory-building in the first half of this year may have been a carryover from 1988 when annual production exceeded sales and use by more than 180 million lb. The 1988 production excess over demand followed a 1987 inventory reduction, when the boom in demand for polypropylene continued after rapid growth that began in 1986.

Production of polypropylene in the first six months of this year, at 3.80 billion lb, up 6.9% over production in the first half of 1988, could be a record that will last another year. Despite capacity additions during the second half of this year of nearly 10% of total capacity at the beginning of the year, industry sources forecast that output in the second half will be lower. Forecasts call for production to be down 100 million to 200 million lb for the second half of 1989, bringing the annual total to about 7.5 billion lb.

Extrusions are biggest market for polypropylene



Total 1988 consumption = 7.1 billion lb

Sources: Committee on Resin Statistics of the Society of the Plastics Industry, C&EN estimates

Sales and captive use of polypropylene during the first six months of this year were up 3.3% over the nearly 3.6 billion lb of the first half of 1988. This growth in consumption was somewhat lower than the 4 to 5% forecast for demand growth for polypropylene during 1989. Forecasters now say that, unless exports spurt unexpectedly, sales and use will not increase much more during the second half of this year. A slight gain may result from inventory reduction efforts and from any shift late in this quarter to the use of polypropylene from the use of HDPE (as a result of the tightened supply and higher prices of HDPE).

Inventory reduction could be even larger than expected if producers with older polymerization units decide that prices have fallen to unprofitable levels and that these units should be mothballed, as some were five years ago. Improving production economics through conversion to more efficient catalysts and through other process changes may not be justified as margins slide and further add incentive to reduce plant operations.

Plant operating rates have been dropping for several months and are expected to continue to drop during the rest of this year and most of next. This year, if 7.5 billion lb of polypropylene are produced and average plant capacity is 8.5 billion lb, the operating rate will be 88.2%, down more than 10% from the 97.3% of nameplate capacity estimated for 1988 (which was a record year).

Falling prices are expected to spur demand next year for both U.S. consumption and for exports, which may reach 1.4 billion lb this year, up from about 1.2 billion lb in 1988 as reported by SPI. Exports could be threatened by new polypropylene capacity to be completed in various parts of the world but especially in the Far East. However, supplies of propylene for these plants are marginally sufficient, and polymer producers face competition from other uses of propylene.

Demand growth in the U.S. is forecast to follow the pattern set recently, with extrusions (especially fibers) continuing to lead. The nonwoven fiber products market, coming from a relatively small base, will grow markedly and may account for more than 8% of consumption of the polymer in 1990, or about half that in woven fiber products. Fiber and filament end-products made using polypropylene will account for more than 28% of total U.S. consumption this year. Filaments will go into such products as rope, twine, decorative ribbon, and bristles. Extruded film, especially the oriented types, used mainly in packaging will be about 10% of consumption and will grow about 7% this year.

Other fast-growing uses are largely in consumer products, mostly formed by injection molding. Examples include furniture such as outdoor seating, housewares, office equipment such as desk files and other small items, luggage and briefcases, toys, and other leisure use items. Injection-molded products forecast to grow more slowly as markets for polypropylene are various appliance parts, cases for automobile storage batteries, and caps and closures. □